

## NATIONAL SEVERE STORMS LABORATORY

### Laboratory Accomplishments

List 3-5 major accomplishments for your laboratory. If accomplishment occurred more than 2 years ago, cite recent progress. Please specify importance of accomplishment, who have been the major users and what has been the benefit to the taxpayer.

Accomplishment	Date	Taxpayer Benefits	Recent Progress
1) Development of Nation's weather radar capability	20 April 1974	<p>* Improvements on Hazardous Weather statistics resulting in substantially better warnings of severe weather hazards and flood/flash flood warnings resulting in saved lives, improved protection of property, and promotion of economic development</p> <p>* Created awareness and understanding of severe storm systems in general public as NEXRAD radar data became a standard product displayed on television</p> <p>* Increased the rate at which rapidly changing weather systems (e.g., severe storms) are scanned, resulting in more frequent updates to public</p> <p>* Improved public information about where storms may develop and where tornadoes may initiate in their local</p>	<p>■ Comparing before Doppler radar in late 1980's with 2002 statistics: All Hazardous Weather statistics: 30% decrease in false alarm rate (.6 to .42), 41% increase in probability of detection (.6 to .845), and 2.5 minute increase in lead time (13.5 to 16 minutes)</p> <p>Tornado Warning statistics: 7.5% decrease in false alarm rate (.81 to .75), 137% increase in probability of detection (.32 to .76), and 7 minute increase in lead time (4 to 11 minutes)</p> <p>■ First observations of a tornadic storm with dual Doppler radars allowed for the mapping of the kinematic structure of a tornadic storm at several altitudes.</p> <p>■ Pioneering studies using dual Doppler analysis also led to the capability of dynamic and microphysical retrievals that provided reasonably accurate estimates of the temperature, pressure and water quantities over three dimensional storm volumes at one time.</p> <p>■ National WSR-88D radar network deployment (1988). Open RPG &amp; RDA (2000, 2004). Improvements to radar performance (1992 – present)</p> <p>■ TDWR deployment (~1994). TDWR algorithm development (1995 – present)</p> <p>■ Pioneered efforts in the area of using dual polarization radar. Improved precipitation measurements and hail identification. Differential phase measurements improved rainfall estimates when significant beam blockage occurs in the western US where beam blocking by mountains occurs.</p>

		<p>area.</p> <ul style="list-style-type: none"> <li>*Improved aviation hazards detection &amp; aircraft safety through improvements in detection of wind shear</li> <li>*Enhanced the understanding of severe weather hazards and their causes that have contributed to better science education in K-12 schools, colleges, and universities.</li> </ul>	<ul style="list-style-type: none"> <li>■ Phased Array Radar for Weather observations. Collaborations with the Navy, OU, Oklahoma State Board of Regents, FAA, Lockheed Martin and BCI have lead to the first Phased array radar dedicated to the study of weather being build at the NSSL. This radar will result in improved detection capabilities, faster scanning leading to improved lead times for severe weather detection especially tornadoes and provides a national facility for continued research in improving weather radar for the detection of severe weather.</li> <li>■ Improved the spatial resolution and basin-total estimate of rainfall as input to hydrologic models.</li> </ul>
2) Understanding storm electrification processes	1980-present	<ul style="list-style-type: none"> <li>*National detection and warning of lightning hazards that have led to enhanced public awareness, mitigation effort, and increased safety.</li> <li>*Enhanced the understanding of lightning hazards and their causes that have contributed to better science education in K-12 schools, colleges, and universities.</li> </ul>	<ul style="list-style-type: none"> <li>■ Intracloud detection of lightning using 3D Lightning Mapping Array (2003)</li> <li>■ Evaluate benefits to forecasters of using total lightning data instead of the presently used cloud-to-ground lightning data by December 2006</li> <li>■ Improve understanding of relationships between total lightning activity and precipitation type and amount, convective development, and hazardous and severe weather to improve the ability of forecasters to make use of lightning data for short-term forecasts and warnings by December 2008.</li> <li>■ Evaluate how to display lightning data with other types of weather data in a format useful for forecasters. Specifically, incorporate lightning data into WDSSII (Warning Decision Support System II) by April 2005.</li> <li>■ Develop and evaluate techniques for assimilating lightning data into numerical forecast models to improve initialization of the forecast period. Develop an initial assimilation technique by January 2005.</li> <li>■ Introduction of electrification processes into cloud-scale models</li> </ul>
3) Developed the first truly mobile capability for	1985-present	Improved forecasts and warnings of severe weather hazards through focused	<ul style="list-style-type: none"> <li>■ Achieved using the Cross-Chain Loran Atmospheric Sounding System mounted in 15-passenger vans modified to be mobile laboratories.</li> <li>■ Pioneered techniques and invented a high-wind launch device for</li> </ul>

obtaining upper-air soundings		<p>observations leading to better understanding of atmosphere.</p> <p>*Enhanced the understanding of severe weather hazards and their causes that have contributed to better science education in K-12 schools, colleges, and universities.</p>	<p>launching helium filled balloons in very high winds allowing upper-air soundings in the vicinity of tornadoes, drylines, etc., obtaining critically needed observations in the near storm environment of thunderstorms.</p> <p>■ Provided the first vertical profiles of electric fields inside a thunderstorm leading to new conceptual model of electrical structures within convective storms.</p>
4) Understanding mesoscale precipitation processes	1974 - present	<p>Improved quantitative precipitation forecasts</p> <p>*Enhanced the understanding of severe weather hazards and their causes that have contributed to better science education in K-12 schools, colleges, and universities.</p>	<p>■ Mesoscale ensemble forecasting</p> <p>■ Better parameterizations of convection in models</p> <p>■ Development of first short-range ensemble forecasting (SREF) system for weather prediction</p> <p>■ NSSL &amp; NWS/NCEP/EMC convened the first workshop on short-range ensemble forecasting in July 1994 in which a 15-member SREF system was designed using both the 80-km Eta and the 80-km RSM forecast models</p> <p>■ September 1994 first SREF forecast produced</p> <p>■ Results indicated that ensemble mean forecasts were comparable in accuracy to the Meso Eta model and contained probabilistic information that can be very beneficial to end users of weather forecasts.</p> <p>■ Led to the inclusion of an operational SREF system in the NCEP model run suite. The SREF system is now a routine and important component of the model guidance provided by NCEP to NWS forecasters.</p> <p>■ NSSL has demonstrated the need to have SREF systems include multiple models with varied physical process parameterization schemes, in addition to perturbed initial and boundary conditions. NCEP is presently developing such an SREF system for its forecast model suite, with the intention that it will become operational within the next year. NSSL is working with the NCEP/SPC on ways to best use SREF data in operational forecasting, and on new techniques to post-process ensemble data.</p>

5) Understanding tornadogenesis mechanisms	2003	*Improved tornado warning and lead times	<ul style="list-style-type: none"> <li>Improved detection by NWS WSR-88D radars</li> <li>Improved conceptual models of storm dynamics</li> <li>Largest ever field experiment (VORTEX I) to study tornadogenesis (1994-1996)</li> <li>Transfer of improved understanding of tornado formation to NWS Storm Prediction Center forecasters and NWS Forecast Offices as evidenced by the improvements in the tornado warning statistics (1999)</li> </ul>
--	------	---	---